## REMARKS

Claims 2-19, 21, and 23-30 are currently pending in this application. Applicant thanks the Examiner for the June 10, 2008 interview conducted regarding this matter, and for the indication that the claim amendments proposed therein appear to overcome the Betzig reference.

Accordingly, claims 21 and 23- 25 have been amended in accordance with the proposed amendments presented to the Examiner during the June 10th interview. Claims 2-19 depend directly or indirectly from amended claim 24 and should be similarly patentable. Claims 18 and 19 have been amended as to a matter of form. New claim 26 has been added and includes the same distinguishing features brought to the Examiner's attention in the interview. Applicants submit that no new matter has been introduced into the application by way of these amendments. New claims 27-30 are also presented.

### Claim Rejections – 35 U.S.C. § 112

Claims 2-19, 21, 23 and 24 have been rejected under 35 U.S.C. § 112, first paragraph, for failing to comply with the written description requirement. In particular, the Office Action states, with regard to the language of independent claims 21, 23, and 24, that "it is unclear how one of ordinary skill in the art would 'to form an image corresponding to variations of the measured parameter during each oscillation.'" Action, pg. 2.

Claims 21, 23, and 24, as amended, now recite "...to form an image corresponding to <u>at least two</u> variations of the measured parameter during each oscillation." As described throughout the specification, the formation of the image corresponding to measured parameters is achieved by any number of conventional methods. For instance, paragraphs [0010] through [0014] describe the use of capacitance, oscillation amplitude, magnetic detection, tapping or AFM as acceptable methods used to form the image.

Similarly, the taking of <u>multiple variations</u> of the measured parameter during each oscillation is described repeatedly throughout the specification. The penultimate sentence of paragraph [0008] of the specification states "[v]ariation<u>s</u> in the measured parameter within the timescale of <u>an oscillation</u> therefore constitute the 'interaction' image, and are interpreted as arising from true surface features." The second sentence of the same paragraph states "[e]ach scan line is collected as a continuous (analogue) image as either the probe oscillates across the surface of the sample or the sample oscillates beneath the probe." The final sentence of this paragraph states "[t]his provides a far more rapid technique with which to collect interaction image information..." Thus, it is clear that the invention relates to a microscope which derives an image from <u>variations</u> in the measured parameter during <u>each</u> oscillation.

Moreover, paragraph [0036] states that "[a]ny changes in capacitance on timescales less tha(n) the period of probe oscillation constitute the image." It follows that a change in capacitance measured in a period of one oscillation or less

can only be determined by taking multiple measurements within a single oscillation. Similarly, paragraph [0038] states that a "collected scan line may be artificially pixelated by the processor." Pixelating a scan line, or an oscillation, infers that multiple data points were gathered for each scan line to form an image. Finally, paragraph [0061] states while measuring the parameters using a tapping means: "...the oscillation frequency is lower than the tapping frequency."[1] Thus, a number of contact points are necessarily sampled within each oscillation. Because of the extensive disclosure of this feature, Applicants respectfully request the withdrawal of the §112 rejections of claims 2-19, 21, 23, and 24.

Claim 25 has been rejected under 35 U.S.C. §112, second paragraph, as being indefinite. Specifically, "the width of the raster scan area" lacks antecedent basis. Moreover, the Action states that it is unclear what "scan area width refers to." Action, pg. 3. By way of this Reply, Applicants have amended claim 25 to read "wherein a raster scan area, comprising a length and a width, is covered..." in order to provide adequate antecedent basis for "the width of the raster scan area". Moreover, Applicants have amended the phrase "scan area width" to recite "the raster scan area width" in order to ensure clarity.

Accordingly, withdrawal of the §112 rejection of claims 2-19, 21, and 23-25 is therefore respectfully requested.

**Claim Rejections – 35 U.S.C. § 102(b)**

[1] This limitation also provides the basis for new claim 26.

Claims 21 and 23 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,254,854 (Betzig). Applicants respectfully traverse these rejections for the reasons set forth in detail below.

Claims 21 and 23, as amended, recite the limitations discussed during the June 10th interview. Specifically, each claim now requires that the length of the scan lines determined by the oscillation amplitude are <u>at least one micrometer</u>, and that the image is formed "corresponding <u>at least two</u> variations of the measured parameter during each oscillation."

As discussed in the interview, every cited prior art reference is devoid of any teaching that resonant oscillation is used to form scan lines or a raster scan and instead teaches direct drive translational movement for this purpose.

Also as discussed in the interview, each resonant oscillation of Betzig is used for shear-force sensing or imaging: "[i]f the probe is oscillated at a frequency which is near resonance, shear forces will shift the resonance either closer to, or further from, the driving frequency. As a result, the oscillatory amplitude of the probe tip will increase or decrease, respectively." Betzig, Col. 3 l. 27-31. It is the amplitude of probe oscillation that is monitored and the output produces one data point.

The setup described in Betzig is not capable of collecting multiple readings per oscillation. Betzig provides an Example at Col. 9 l. 15 et seq. in which oscillation amplitude is the interaction parameter. In particular, Betzig states: "The output of the lock-in amplifier represented the demodulated shear-force signal. The lock-in amplifier typically had an <u>output time constant of 0.1 ms</u>." Col. 10 l. 17-

19, underlining emphasis added. And a "typical resonant frequency was about 80 kHz." Col. 10 l. 31. In other words, the period of one oscillation of the probe is 1/(80,000) ~ 0.01 ms, which is a factor of 10 shorter than the period required to collect a signal interaction reading. Thus, the setup as presented in Betzig is not capable of collecting multiple reading during a single oscillation of the probe, rather the probe must perform 10 oscillations to collect a single reading.

Based on the foregoing, the probe of Betzig must complete at least one sweep (or dither line) before a <u>single</u> variation in amplitude can be determined. Accordingly, it is impossible for the device of Betzig to measure "at least two" variations of this parameter along a single oscillation dither line, and therefore, the oscillation cannot be the scan line along which the sample is imaged. Instead, Betzig teaches direct drive translational movement to forms scan lines.

Moreover, if the oscillation amplitude of Betzig were increased to the width of the scanned area, specifically, the at least one micrometer as required by the claims (up from a range of 5-10 nm as described in Betzig, Col. 3 l. 47-54), the single image point gathered by Betzig would correspond to the entire width of the sample. That is, the resolution of the device would be dramatically reduced. Betzig clearly teaches a direct drive translation to move a dithering probe the length of the sample. And reducing the resolution by a factor of 1000 is completely contrary to the teachings of Betzig, and would essentially destroy all functionality of the device. The resulting image would simply be stripes corresponding to the single data point gathered over each translational scan line across the width of the sample.

As discussed above with respect to the §112 rejection, the present invention fundamentally differs from Betzig in that it utilizes an oscillating probe not as a means to measure a change in oscillatory amplitude, but rather, as a means to sweep the probe over the entire width of a scan area. The oscillation is produced by means of resonance rather than through a direct drive translational movement. Accordingly, the present invention is capable of measuring <u>at least two</u> variations in the measured parameter within the one oscillation of at least one micrometer and is distinct from the device of Betzig, which cannot measure more than a single variation over the same period, nor can it retain its function using such a large oscillation length.

Because independent claims 21 and 23 are distinguishable from Betzig, withdrawal of the §102 rejection of these claims is respectfully requested.

**<u>Claim Rejections – 35 U.S.C. § 103(a)</u>**

***1. Betzig in view of Elings et al.***

Claims 3, 12-18, 24, and 25 have been rejected under 35 U.S.C. § 103(a) as being obvious over Betzig in view of U.S. Patent No. 6,008,489 (Elings et al.). Applicants respectfully traverse these rejections for the reasons set forth in detail below.

By way of this Reply, independent claims 24 and 25 have been amended in accordance with the proposed amendment presented to the examiner during the June 10th interview. Specifically, each amended claim requires that the length of the scan lines determined by the oscillation amplitude are <u>at least one micrometer</u>,

and that the image is formed "corresponding at least two variations of the measured parameter during each oscillation." Accordingly, these claims are distinguished over Betzig for the reasons described in detail above.

Although Elings teaches using averaging values taken over plurality of data points to provide increased accurate adjustment and detection, Elings fails to overcome any of the above noted shortcomings with respect to Betzig. Elings makes no teaching of utilizing a probe with an oscillation length of at least one micrometer, nor the ability to record at least two variations over such a length. Claims 3 and 12-18 depend directly or indirectly from claim 24 and should be similarly patentable.

Accordingly, withdrawal of the §102(b) rejection of claims 3, 12-18, 24 and 25 is respectfully requested.

*2. Kley in view of Betzig and Elings (and Ookubo)*

Claims 2-4, 6-19, 21 and 24 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,752,008 (Kley) in view of Betzig and Elings. Claim 5 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Kley in view of Betzig and Elings and further in view of U.S. Patent No. 6,614,227 (Ookubo).

As set forth above, claims 21 and 24 as amended, recite that the microscope is arranged "to form an image corresponding to at least two variations of the measured parameter during each oscillation." Applicants respectfully submit that neither Kley, Betzig, Elings, nor Ookubo, alone or in combination, teach or suggest

forming an image corresponding to at least two variations in a measured parameter during resonant oscillations.

The Action indicates that Fig. 3 of Kley shows a "relative oscillatory motion...of the probe across the surface ... [and] each scan line provided by laterally oscillating either the probe or the sample at a frequency. The oscillation amplitude inherently ... determines a maximum scan line length." To the contrary, Kley discloses the use of a probe translated by a direct drive mechanism, preferably a piezoelectric device, in the X-Y and Z directions. Col. 3 l. 11-22. This is inherently distinct from the use of a resonant oscillating device as taught by the present invention.

Contrary to the Examiner's assertion, Fig. 3 discloses the use of a zig-zag trajectory rather than an oscillation path. As noted in Col 6, l. 37-50, the zig-zag pattern is formed by consecutively connected linear segments. The lengths of these segments are adjusted to change the density with which a particular region is scanned. Specifically, "[a] line segment that is shorter...allows a higher number of samples per unit area scanned and thus a higher scan resolution. A line segment that is longer...allows a lower number of samples per unit area scanned and thus lower scan resolution." Col. 6, l. 55-60. This is the result of the data points of Kley being taking between the linear segments defined by the direct drive, rather than along the oscillation path as performed by the present invention. Therefore, the device in Kley suffers from a similar drawback to that described above with respect

to Betzig, namely, reduced resolution as the length "oscillation" is increased. The present invention does not suffer from these shortcomings.

The Action expressly admits that Kley does not disclose resonant oscillation. See Office Action at pg. 6. However, as noted above, the Action applied Betzig for its disclosure of resonant oscillation. As discussed in detail above with respect to the rejections of claims 21 and 23, the resonant oscillations of Betzig are used to take a single measurement, and are not used to provide a scan line having a plurality of readings. Therefore, the combination of Kley with Betzig would result in oscillations along the discrete linear segments of Kley, just as Betzig utilizes oscillations along each slowly transcribed direct drive scan line. In contrast, as stated in the specification, oscillation offers higher stability and rates. Paragraph [0008]. The present invention is distinct from Kley in that an oscillation of sufficient length to traverse the entire scan width can be utilized, while maintaining adequate resolution.

Accordingly, withdrawal of the obviousness rejection of independent claims 21 and 24 is respectfully requested. In addition, claims 2-5 and 6-19, which depend from independent claim 24 are distinguishable from the cited prior art for the same reasons.

**New Claims**

New claim 26 depends from claim 24 and Applicant submits that the new claim is patentable for the same reasons as set forth above.

New claims 27 – 30 are similar to the proposed claim presented in the interview. New claims 27 – 30 each recite that an image is formed based on at least two variations of the measured parameter during each oscillation. As set forth above, none of the cited prior art references disclose collecting multiple data points within one oscillation. Applicant noted this distinction in the interview while discussing proposed claims but the proposed claim presented also included a limitation regarding oscillation amplitude. Applicant submits that new claims 27 – 30 are patentable over the cited prior art references.

## Conclusion

If the Examiner believes that any additional matters need to be addressed in order to place this application in condition for allowance, or that a telephone interview will help to advance the prosecution of this application, the Examiner is invited to contact the undersigned by telephone at the Examiner's convenience.

In view of the foregoing remarks, Applicants respectfully submit that the present application, including claims 2-19, 21, and 23-30, is in condition for allowance and a notice to that effect is respectfully requested.

Respectfully submitted,

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